longest due to the more difficult dissection of the large aortic aneurysm.

The LOS was longest in the robotic-assisted ABFB group because of the severity of patient comorbidities. One patient in this group also underwent left femoral-posterior tibial bypass and toe amputation during the same hospitalization for limb salvage, thus increasing his overall LOS.

Others may question the expense and availability of the robotic system. Many hospitals in the United States own at least one da Vinci Surgical System; thus, there is no additional fixed cost. Our current protocol uses four robotic instruments—hook electrocautery, bipolar grasper and cautery, needle holder, and scissors—for the entire colonic mobilization, aortic dissection, and vascular reconstruction. The other instruments are reusable, laparoscopic instruments from the assistant's port that are readily available in most operating rooms. Limiting the number of robotic instrument exchanges will lower the overall cost of the procedure.

CONCLUSIONS

In this selected group of patients, total robotic-assisted aortic surgery for aortic dissection and vascular reconstruction is feasible. With further advancement of robotic technology and instrumentation, robotic-assisted aortic procedures may expand the armamentarium for vascular surgeons as a primary or adjunctive intervention for patients with aortoiliac occlusive or aneurysm disease.

AUTHOR CONTRIBUTIONS

Conception and design: JL
Analysis and interpretation: JL, SK, AB, EP
Data collection: JL, SK, AB
Writing the article: JL
Critical revision of the article: JL, SK, AB, JP, MM
Final approval of the article: JL, SK, AB, JP, MM
Statistical analysis: EP
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Overall responsibility: JL

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INVITED COMMENTARY

Michael Belkin, MD, *Boston, Mass*

Lin and coauthors have nicely described their experience with robotic-assisted laparoscopic aortic surgery. Because of the small number of patients, the diversity of operations, and the intraoperative selection process, their attempts to compare fully robotic reconstructions with those that included minilaparotomies are somewhat over-reaching. The authors do document, however, that with appropriate expertise and dedication, robotic aortic surgery is feasible. Whether it is practical or appropriate for prime-time vascular surgery is an entirely different question.

Laparoscopic aortic surgery was introduced nearly a decade ago, yet it remains an operation largely relegated to small case series in the literature. Less invasive endovascular treatment of aortoiliac occlusive and aneurysmal disease has become the mainstay of therapy and will continue to grow as technology and skills evolve. Nonetheless, open

operations for aortic occlusive disease and aneurysms remain an effective and essential part of the therapy we offer patients.

However, it has become a major concern if vascular surgeons will perform enough open aortic operations in the future to maintain their skills. This is particularly true in that open operations are often performed in patients with the most complex anatomy. As such, is it unrealistic to assume that vascular surgeons will have sufficient skills and experience to conduct these more complex operations laparoscopically, with or without a robot? Furthermore, new training paradigms in vascular surgery with less general surgery exposure are unlikely to afford the next generation of vascular surgeons the necessary laparoscopic and robotic skills to perform these procedures safely. It is telling that four of the five authors of this article are urologists who routinely use the surgical robot in their operations.

It is essential for vascular surgeons to remain in the vanguard, using and evaluating all available technologies to improve our care of patients. The authors are to be congratulated for their successful application of advanced robotic technology to the treatment of aortic disease. In those few centers where there is the constellation of appropriate interest, expertise, and equipment, the technique is feasible. It remains to be demonstrated in these centers if this approach will offer advantages over well-done open surgery. As endovascular therapy evolves and open surgery becomes more uncommon, the widespread feasibility and utility of this approach is more questionable.